

1 **Wireless Interactive Rendezvous System for Delivering Goods and Services**

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3 Background of the Invention

4 Fast food and other items and services are often ordered by mobile customers
5 via cellular telephone, personal data assistant (pda) or other wireless data services, but
6 delivery of the order must typically be made at a food stall, kiosk or other predetermined
7 fixed location. Economies of costs and time can often be achieved if a less-constrained
8 rendezvous point for delivery could be identified. Even greater savings can be achieved
9 when the location and time of the rendezvous can be dynamically updated if external factors
10 affect the travel of the customer and/or the delivery person.

11 Computer-based methods and apparatus for planning a multidimensional rendezvous
12 based on multiple space-time constraints are described in US Patent 6,324,476, which is
13 incorporated herein by reference.

14 Inexpensive portable location determining apparatus with horizontal
15 resolution of a few meters, typically utilizing the Global Positioning System (GPS), are
16 currently available in the consumer market. Government regulations in the United States will
17 soon require an emergency location determining functionality with 50-meter accuracy (E911)
18 in all cellular telephones. Centrally assisted systems that utilize GPS signals to provide
19 location information are described in US patent RE 35498. Snaptrack Inc. of Campbell CA
20 offers a similar thin client locator technology as a commercial product. Locator systems

1 based upon triangulation of cellular telephone signals are also being currently marketed. It is
2 also commonly known that the resolution of a GPS location system may be further improved
3 by utilization of map matching and dead reckoning techniques.
4

5 The Invention

6 The invention is a method and system that coordinates time and position
7 information, including the geographic position of a wireless device which is used to place an
8 order, with route and delivery system information to allow dynamic delivery of fast food,
9 personal items or other goods and services to customers who are walking, driving or
10 traveling.

11 As used herein and in the claims that follow, unless the context requires
12 otherwise, the term "position" refers to a point in space and time while the term "location"
13 refers to a point in space.

14 As an example of the invention, a group of office workers may decide to eat
15 lunch in a park. Before they leave their office, they place their food order via a cellular
16 telephone or a wireless pda that includes position-determining functionality (e.g. GPS,
17 Snaptrack, other e911 service etc). In response to menu questions, they indicate that they
18 would like dynamic delivery of the food on their way to the park, their expected departure
19 and/or arrival time, their method of transportation, and their expected route from their office
20 to the park. The order information is entered into a system server that also has access to

1 databases that include: maps and other routing information, various locations where the food
2 order can be prepared, estimates of expected preparation time for the food items ordered,
3 location and availability of potential deliver persons, and information about other pending
4 and anticipated orders. Using this information the server chooses a preparation location and
5 delivery person and then calculates a candidate rendezvous position where the customers and
6 the delivery person can meet to effect delivery of the food. The server transmits this
7 information to the customer's pda. The customers can either confirm or the candidate
8 position or make proposals for modifications thereof.

9 Once the order has been confirmed, the server uses position information from
10 the customer's pda, order status information from the preparation location and position
11 tracking information from a pda or other locator module that is carried by the delivery person
12 to monitor and, if necessary, dynamically update the rendezvous position. Messages can be
13 sent in real time to enable the customers and delivery person to find and identify each other.
14 If the order has been charged to a credit card or other account, the server can also send a
15 confirming message to the customers' pda that verifies payment and authorizes the delivery
16 person to turn-over the order to the customers.

17 Thus, principal features of a method in accordance with the invention are: receiving
18 order data from a customer's wireless terminal that is collocated with the customer , which
19 order data includes the type and quantity of items of goods and/or services ordered, the
20 present position of the customer's wireless terminal, and one or more points along the

1 customer's anticipated route of travel; identifying one or more supply locations from which
2 the ordered items can be supplied; identifying one or more possible deliverers for the ordered
3 items; determining rendezvous criteria for the customer and each identified deliverer from
4 each identified delivery location; calculating candidate rendezvous positions which satisfy
5 the determined criteria; and sending information proposing delivery rendezvous positions to
6 the customer's wireless terminal.

7 In further embodiments of the invention a server computer may also calculate one or
8 more proposed routes for the customer to each proposed rendezvous position and may use
9 travel method and constraint information in such calculation.

10 When a customer authorizes a delivery, the server computer may also dispatch a
11 selected deliverer to deliver the items from a selected supply location to the selected one
12 rendezvous position; and calculate a route for the deliverer to follow from the selected
13 delivery position to the selected rendezvous position.

14 In a further preferred embodiment the server computer may receive from the
15 customer's wireless data terminal and from a deliverer's wireless data terminal which is
16 collocated with the deliverer, data which indicates their respective actual positions enroute to
17 an intended rendezvous position and recalculate an updated rendezvous position based upon
18 the actual positions of the customer and the deliverer.

19 The invention also includes a server computer that is programmed to implement the
20 previously described method steps and a wireless data terminal for use by a customer when

1 making use of the methods.

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The Drawings

4 The invention will be described with reference to the drawings, in which:

5 Figure 1 illustrates a typical delivery scenario;

6 Figure 2 is a flow diagram of information processing in the server computer; and

7 Figures 3 and 4 show candidate routes and rendezvous positions.

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Description of a Preferred Embodiment

10 Figure 1 is a map that illustrates a typical delivery scenario in accordance with
11 the invention that takes place in an urban setting. The setting includes blocks of buildings
12 separated by streets S1, S2, ... and a limited access highway H1. Some of the streets (S3,
13 S4) are limited to one-way traffic. Vehicular and pedestrian traffic at selected street
14 intersections is controlled by traffic signals 10, 11, 12 and 13. Pedestrian traffic across street
15 S1 is further blocked at central intersections by a barrier 14. Alley A1 is open to pedestrian
16 and bicycle traffic, but is closed to motor vehicles.

17 A park 20 is bisected by highway H1 and includes walking paths 21, a lake
18 22, a forest 23, and a fountain 24. Bicycle access to the park from surrounding streets is only
19 permitted through gates 25 – 28, but pedestrians may enter anywhere along the park
20 perimeter. A car parking lot 31, with vehicle entrance 32 is located next to the west side of

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1 the park. An enclosed shopping mall 40 is located to the south of the park.

2 The area illustrated in the map is served by a two-way, cellular voice and data
3 system with wireless handset location capability. Cell antennas are deployed at locations 50,
4 51 and 52.

5 A customer's office 60 is located in a building in the southwest quadrant of
6 the map. A food delivery service company has a central service facility 70, located outside of
7 the city center to the west, and a number of smaller facilities 71, 72, 73 and 74 at locations
8 within the central mapped area.

9 The food company has a server computer 80 located in or accessible from its
10 central facility 70. The computer server is linked by radio or telephone connections to slave
11 computers and/or terminals at each of the smaller facilities from which it receives regular
12 reports of data which indicate the types and quantity of food which are and will be available
13 at the central and smaller facilities, the time required to prepare items of the available the
14 food and the status of any food orders queued for delivery. This information is maintained in
15 a database on the server.

16 The food company utilizes a number of delivery persons, who may be
17 dedicated employees of the service, or independent contractors. Some of the independent
18 contractors may provide delivery services on a shared basis, for example: the delivery
19 company may utilize off-duty police officers as delivery persons or taxi drivers at times
20 when they are not carrying regular passengers. Each delivery person carries or otherwise has

1 in his vicinity a wireless mobile data device that is programmed to regularly report to the
2 server the location of the delivery person and his status (that is: whether he is engaged in a
3 delivery, free to make a delivery, and/or otherwise occupied). The delivery person will
4 typically manually enter changes in status into the data device. The current location of each
5 delivery person, his status and his mode of transportation are maintained in a database on the
6 server. The database may also maintain information about any special constraints that affect a
7 particular delivery person. For example, a delivery person who is wearing a uniform or other
8 type of dress may not be permitted in some buildings or an armed delivery person may be
9 excluded from some public buildings and transportation facilities.

10 The server also maintains a third database which includes map data of the
11 delivery area and information defining obstacles to the movement of customers and delivery
12 persons that is used to calculate proposed rendezvous positions as described below. As
13 recognized by the abovementioned U.S. patent 6,324,476, these obstacles may be used to
14 define a unique configuration space for each actor (i.e., for each customer and delivery
15 person). Thus a delivery person traveling by automobile could be constrained to move along
16 a route that principally utilizes streets, highways and parking lots, subject to various traffic
17 restrictions. Alternately, a bicycle delivery person could be restrained to routes along regular
18 streets, alleys and park gates and paths, but excluded from travel through shopping malls and
19 woods. Likewise, a delivery person traveling on foot can move freely through most malls
20 and woods, but would not usually travel across a lake or along a highway. Obstacles may be

1 time dependent. For example, park gates and shopping malls may close at certain hours,
2 traffic and parking rules may be time limited, and certain streets may be judged to be unsafe
3 at various times of the day. Travel across a frozen lake might be considered acceptable in the
4 coldest part of the winter. The database may also include information that estimates the speed
5 that each actor is likely to achieve when moving in various portions of a route.

6 Certain locations that do not represent obstacles to travel may nonetheless be
7 unsuitable for a delivery rendezvous. For example, food could not generally be delivered in
8 the middle of a street with traffic. The customer or the delivery service might not wish to
9 conclude a food delivery near a trash dump, public bathroom, or a competitor's restaurant, or
10 a financial service transaction in an unsafe neighborhood. Likewise, certain locations may be
11 preferred for a rendezvous. Delivery from a vehicle may be most effectively concluded in a
12 parking lot and a sheltered, indoor delivery location may be preferred on rainy days. Relevant
13 information can be stored in the third database and used in conjunction with a cost metric to
14 calculate candidate rendezvous times and locations.

15 Figure 2 is a flow chart that illustrates a typical transaction.

16 At step I, a customer in office 60 uses a wireless data terminal to place an
17 order for food with the food company. The customer's terminal exchanges messages with the
18 server and displays a series of questions or menus through which the customer indicates his
19 choice of food items, a time or range of times when he would prefer to have the items
20 delivered to him and his travel plans around the delivery time or times. For example, at 11:45

1 am the customer might indicate that he desired delivery of a chicken sandwich anytime
2 before 12:30 pm and that he plans to remain at his present location until 12:00 noon and then
3 travel by walking to the fountain 24 in park 20.

4 At step II, in response to the order the server 80 checks its database to
5 determine whether the item ordered could be available in the desired time frame, before
6 12:30, at each of its facilities (70 – 74). This determination could include checking whether
7 the required ingredients for the sandwich are or will be available at the facility and the length
8 of any queue of orders waiting to be filled at the facility. At step II, the server also checks
9 whether one or more deliverpersons are available to make a delivery from each facility
10 during the relevant time frame. For this purpose, each delivery person may carry or remain
11 close to a wireless terminal that regularly transmits their location and status to the server. On
12 the basis of information determined in steps II and III, the server makes a list, Step IV, of
13 potential facilities from which delivery can be effected. For example, The server might
14 determine that the sandwich could be prepared either at facility 80, where a taxi driver
15 would be available to make a delivery starting at 12:20; at facility 74, where a bicycle
16 delivery person could be available to make a delivery anytime after 12:00; at facility 73,
17 where a pedestrian delivery person could be available at 12:25 or at facility 71, where the
18 food could be prepared by 12:15 but no delivery person could be available before 12:30.

19 At step V, the server applies the rendezvous calculation methods and
20 algorithms, for example as taught in U.S. patent 6,324,476, to determine potential positions

1 for a delivery using map and obstacle information corresponding to the map of Figure 1 and
2 separate cost metrics for the customer and each potential delivery person. For example, the
3 cost metric for the taxi driver could in part correspond to the distance/time based tariffs used
4 for taxi meter charges and would constrain the delivery route to legal movements along
5 streets, highways and parking lots while the cost metrics for bicycle and foot delivery could
6 be primarily based on time spent enroute. The customer's cost metric might be biased to
7 minimize distance traveled and/or to avoid unsafe or congested streets.

8 At step VI, the food company may consider some potential rendezvous times
9 or locations to be undesirable, more desirable or less desirable for deliveries. For example,
10 the company may decide to exclude all deliveries in or along busy streets, near public
11 restrooms and adjacent competitors business establishments. Deliveries from taxis may be
12 less expensive and thus more desirable if they are made from parking lots. These and similar
13 criteria can be used to generate an ordered list of candidate rendezvous positions from those
14 that were identified during step V.

15 At step VII the list of candidate rendezvous positions is transmitted to the
16 customer's terminal. The customer chooses a one of the positions from the list for delivery
17 and transmits a confirmation message to the server. The confirmation message may include
18 authorization to charge the customer's account or credit card for the items and delivery
19 service provided.

20 At step VIII, the server places the order with the relevant facility and delivery

1 person to initiate preparation and delivery of the food. The order to the delivery person will
2 generally include specification of a particular route from the preparation facility to the
3 selected rendezvous position that was determined during the rendezvous calculation step.
4 The server may also transmit to the customer a suggestion that the customer follow a
5 calculated route to the rendezvous.

6 At step IX, the server regularly polls the facility selected for preparing the
7 food, the customer's terminal and the delivery person's terminal to monitor the status of the
8 order and the locations of the customer and delivery person. If the customer or delivery
9 person deviate from their expected routes, or from their expected progress along the expected
10 routes, the server calculates a new expected delivery time and advises transmits messages to
11 advise the customer and delivery person. If necessary the server can calculate a new
12 rendezvous location based on the progress of the actors.

13 At step X, The customer and delivery person meet at the rendezvous site and
14 delivery is made. If the customer and delivery person are both at the same location, but are
15 for some reason unable to identify each other, the server may assist identification by sending
16 further messages to their respective terminals. For example, simply causing a tone to be
17 emitted from his terminal upon request by the delivery person may effect identification of a
18 customer. In a preferred embodiment the server also transmits a coded message to the
19 customer's terminal which the customer can show to delivery person to confirm his identity
20 before the food is turned over. The delivery person transmits a message that informs the

1 server that the transaction has been completed and the server updates its databases
2 accordingly.

3 Figure 3 is a map corresponding to Figure 1 that is overlaid to show an
4 example of routes and possible rendezvous locations between a customer who leaves
5 building 60 at noon and a delivery person who leaves location 70 traveling by taxi at 12:20
6 pm. The taxi follows route R_T along the highway H1 and then onto street S1. The customer
7 may take alternate routes R_1 or R_2 respectively along street S1 to two potential rendezvous
8 positions: X_1 on the street outside of park gate 27 at 12:27 pm and X_2 in parking lot 31 at
9 12:30. The server may be programmed to favor the second rendezvous location X_2 because a
10 parking lot rendezvous is considered to be less costly than is a curbside rendezvous on a busy
11 street.

12 Figure 4 is the map of Figure 1 corresponding to Figure 1 that is overlaid to
13 show an example of routes and possible rendezvous locations between a customer who
14 leaves building 60 at noon with a bicycle delivery person who leaves location 74 at noon and
15 with a pedestrian delivery person who leaves location 73 at 12:25. The bicycle delivery
16 person follows route R_B to gate 26 and thence along park paths 21 to a 12:10 rendezvous at
17 fountain 24. The pedestrian delivery person follows route R_P along street S1, but is only able
18 to reach a candidate rendezvous location at gate 27 by the 12:30 time limit. In both cases the
19 customer follows route R_3 along street S1.

20 Finally, the server also determines that a vestigial rendezvous would be

1 possible if the customer picked the food item up himself, without delivery, after 12:15 at
2 location 71 in the mall 40 and then walks to the park.

3 In a further preferred embodiment, the server may store customer preference
4 information in a database that can be used to modify cost metrics or to eliminate potential
5 rendezvous sites from the list. Customer preference information may be collected by
6 gathering information from previous orders of the same or statistically related customers, or
7 may be directly entered into the database by the customer. Preference information could, for
8 example include lists of favorite delivery persons, typical walking speed or travel times
9 between various points, preferred routes, or a preference not to pickup food at fixed
10 locations.